

Ultraefficient Thermoelectric Devices, Phase II

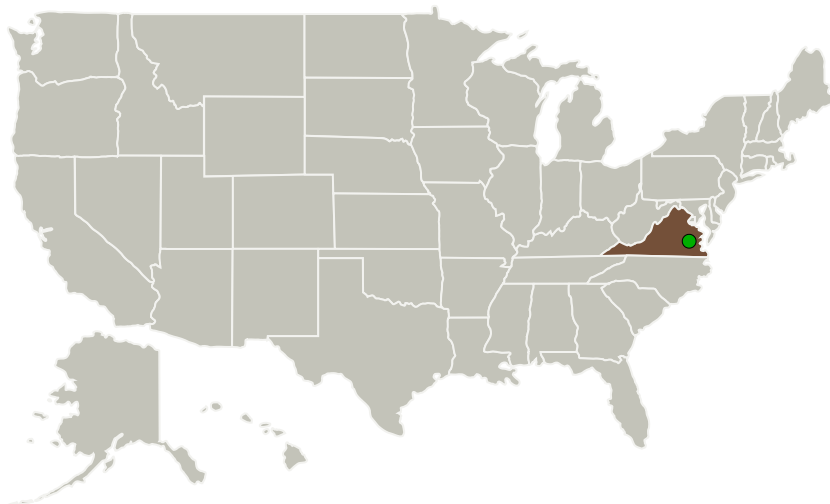
Completed Technology Project (2010 - 2013)



Project Introduction

Thermoelectric (TE) devices already found a wide range of commercial, military and aerospace applications. However, at present commercially available TE devices typically offer limited heat to electricity conversion efficiencies, well below the fundamental thermodynamic limit, calling for the development of higher efficiency materials. The team of MicroXact Inc., Virginia Tech and Sundew Technologies Inc. is proposing to develop a revolutionary ultrahigh efficiency thermoelectric material fabricated on completely new fabrication principles. The material comprises the three-dimensional "wells" of Bi₂Te₃/Bb₂Te₃ Quantum Well Superlattices fabricated by a conformal coating of macroporous silicon (MPSi) pore walls. Such a material will provide $ZT > 2$ at macroscopic thicknesses of the material, permitting 15% or more conversion efficiencies. In Phase I of the project the thorough model of the proposed TE material was developed, the achievable efficiency and ZT of the material were confirmed through numerical modeling, and conformal coating of pore walls with Sb₂Te₃ was experimentally demonstrated, validating the proposed concept. In Phase II the team will fabricate the proposed material and device, and will demonstrate $ZT > 2$ and conversion efficiencies exceeding 15%. After the Phase II MicroXact will commercialize the technology.

Primary U.S. Work Locations and Key Partners



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| Organizations Performing Work | Role | Type | Location |
|--|-------------------------|-------------|----------------------|
| MicroXact, Inc. | Lead Organization | Industry | Radford, Virginia |
| ● Langley Research Center(LaRC) | Supporting Organization | NASA Center | Hampton, Virginia |
| Virginia Polytechnic Institute and State University(VA Tech) | Supporting Organization | Academia | Blacksburg, Virginia |

Primary U.S. Work Locations

Virginia

Project Transitions

**September 2010:** Project Start**January 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140864>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

MicroXact, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Vladimir Kochergin

Co-Investigator:

Vladimir Kochergin

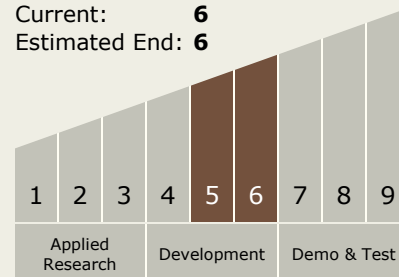
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Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.1 Materials
 - └ TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System